Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Amendment of the Commission's Rules to Permit Radiolocation Operations in the 78-81 GHz Band	)	WT Docket No. 11-202
	)	
Request by the Trex Enterprises Corporation for Waiver of Section 90.103(b) of the Commission's Rules	)	RM-11612

REPLY COMMENTS OF THE NATIONAL ACADEMY OF SCIENCES' COMMITTEE ON RADIO FREQUENCIES

The National Academy of Sciences, through the National Research Council's Committee on Radio Frequencies[1] (hereinafter, CORF), hereby submits its Reply Comments in response to the Commission's December 20, 2011 Notice of Proposed Rulemaking in the above-captioned docket (NPRM). In these Reply Comments, CORF discusses the importance to the Radio Astronomy Service (RAS) of observations at 78-81 GHz, and notes that it does not oppose sharing of spectrum in this band with a service permitting fixed radars at airports to monitor foreign object debris (FOD). CORF suggests, however, that such a service be a licensed one, with a requirement for coordination with certain RAS facilities. A coordination requirement should not be a significant burden on the operators of such radars, given the limited number of radio

[1] A committee roster is given in Appendix A.

astronomy facilities that observe in the 78-81 GHz band, and the ease with which any potential interference could be mitigated.

I. Introduction: The Role of Radio Astronomy, the Unique Vulnerability of Passive Services to Interference.

CORF has a substantial interest in this proceeding, as it represents the interests of the passive scientific users of the radio spectrum, including radio astronomers and earth remote sensing scientists. RAS observers perform extremely important, yet vulnerable research.

As the Commission has long recognized, radio astronomy is a vitally important tool used by scientists to study our universe. It was through the use of radio astronomy that scientists discovered the first planets outside the solar system, circling a distant pulsar. It has also enabled the discovery of organic matter and pre-biotic molecules outside our solar system, leading to new insights into the potential existence of life elsewhere in our Galaxy. Measurements of radio spectral line emission have identified and characterized the birth sites of stars in our own galaxy, the processes by which stars slowly die, and the complex distribution and evolution of galaxies in the universe. Radio astronomy measurements have discovered fluctuations in the cosmic microwave background, generated in the early universe, which later formed the stars and galaxies we know today. It has established the existence of a black hole in our Galactic Center, a phenomenon that may be crucial to galaxy formation. Observations of supernovas have allowed us to witness the creation and distribution of heavy elements essential to the formation of planets like Earth, and of life itself.

However, the critical science undertaken by RAS observers cannot be performed without access to an interference-free spectrum. Notably, the emissions that radio astronomers receive are extremely weak—a radio telescope can receive less than 1% of one-billionth of one-billionth of a watt (10^{-20} W) from a distant cosmic object. Because radio astronomy receivers are designed to pick up such remarkably weak signals, radio observatories are particularly vulnerable to interference from in-band emissions, spurious and out-of-band emissions from licensed and unlicensed users of neighboring bands, and emissions that produce harmonic signals in the RAS bands. The interpretation and use of these signals is critically impacted by the received bandwidths. Even weak, spatially distant in-band man-made emissions can preclude RAS use.

In sum, the important science performed by radio astronomers cannot be performed without access to an interference-free spectrum. Loss of such access constitutes a loss for the scientific and cultural heritage of all people, as well as for the practical applications from the information learned and the technologies developed.

It should be noted that the RAS has a primary allocation at 78-81 GHz. Thousands of strong spectral lines are catalogued within this frequency range. Of particular importance in this proceeding are observations of deuterated molecules, long-chain molecules and sulfur dioxide. These long chain molecules could be the progenitors of life and hence very important to our study of the universe. This band can also be used for the sensitive characterization of continuum phenomena from various physical mechanisms.

II. CORF Does Not Oppose Use of the 78-81 GHz Band for Fixed Airport Radars as a Licensed Service, Subject to a Coordination Requirement.

CORF recognizes the possible public interest benefits of using airport radars to locate FOD. CORF also recognizes the importance of maximizing spectrum efficiency through thoughtful sharing of spectrum bands, and accordingly, CORF does not oppose use of the band for fixed airport radars. However, in light of the possibility of interference to vulnerable RAS observations given the allowed power levels CORF suggests that any allocation for fixed airport radars be a licensed service, with a requirement for coordination with certain RAS facilities. CORF recommends that this airport radar service be licensed since it is manifestly easier to identify and contact a licensed entity that is causing interference, than to do so with an unlicensed operator.[2] This point was also made in "Comments of Robert Bosch, GmbH," page 10, filed with the Commission in regards to the same matter on February 8, 2012.

In paragraph 12 of the NPRM, the Commission seeks comments regarding measures to mitigate interference to RAS facilities. CORF concurs with the proponent of this rulemaking, Trex, that there should be direct coordination between the operator of such airport radars and the Electromagnetic Spectrum Manager of the National Science Foundation (NSF), if the operator is within a certain radius of a listed RAS

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[2] In para. 11 of the NPRM, the Commission seeks comments on whether, if airport FOD radars are authorized under Part 15, equipment manufacturers should be required to maintain records of FOD equipment that they sell or operate, including the address or coordinates of the applicable airports. If the Commission authorizes FOD radars under Part 15, then it certainly should require the creation and retention of such records, in order to facilitate attempts to identify sources of interference. However, identifying sources of interference would be significantly quicker and more effective if the Commission had that information in its own records, as part of the Part 90 licensing process.

facility. See page 8 of the November 3, 2010, Trex Petition for Rulemaking. The Trex Petition lists as sites for coordination, all of the observatories that together comprise the Very Long Baseline Array (VLBA), along with the observatories at Green Bank, West Virginia, Kitt Peak, Arizona, Cedar Flat, California, and Owens Valley, California with which we concur. In addition to the RAS facilities listed in the Trex Petition, the following facilities that observe in this band should also be protected by coordination:

- Haystack Observatory, Westford, Massachusetts: 42°37'24" N; 71°29'18" W
- Mt. Graham International Observatory, Arizona: 32°42'05" N; 109°53'28" W

CORF believes that coordination should occur with airport radars located within 90 kilometers of the listed RAS facilities.[3]

In paragraph 12 of the NPRM, the Commission indicated that the coordination procedure proposed by Trex is "unnecessarily burdensome." The Commission

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[3] This 90 km distance is calculated as follows: The ITU RA.769 levels in the 77-82 GHz range are:

Threshold interference levels for Continuum Observations:
power flux density (pfd) -129 dBW/m^2 Spectral pfd -228 dBW/m^2/Hz
Threshold interference levels for Spectral-line Observations:
pfd -148 dBW/m^2 Spectral pfd -208 dBW/m^2/Hz
Threshold interference levels for VLBI Observations:
Spectral pfd -172 dBW/m^2/Hz

Assuming (pursuant to para. 18 of the Order in FCC 11-185) a transmit signal of +35 dBW effective isotropic radiated power (EIRP), and an atmospheric free space attenuation of 0.15 dB/km, then a distance of 290 km is needed to get down to -129 dBW/m^2. Total loss, however, also includes diffraction loss if not direct line of sight. The 290 km is over the horizon unless the site of the airport is 6 km up or both airport and site are on mountains separated by a valley and therefore generally not line-of-sight. The single-dish pfd similarly leads to this situation. For VLBI, assuming that the radar has a bandwidth of 200 MHz then the spectral EIRP is -48 dBW/Hz then -172 dBW/m^2/Hz is reached at 90 km, which is therefore recommended as the coordination distance.

apparently bases this conclusion by comparing the likely limited number of airport FOD radars with the "ubiquitous" number of vehicle-mounted 14 GHz earth stations that are subject to a coordination requirement. However, the fixed and permanent nature of airport FOD radars, along with their substantial power, means that they are capable of creating substantial harmful interference to RAS facilities if the RAS receiving antenna has a clear line of sight to (1) the primary beam of the radar transmitting antenna, (2) specular reflections of the radar beam from intervening objects, or (3) possibly near-in sidelobes of the primary beam of either antenna. Nevertheless, compliance with a coordination requirement should not be burdensome for airport radar operators, as only an extremely small percentage of U.S. airports are within the proposed coordination distances. Furthermore, in the unlikely situation that interference to an RAS facility is predicted, then coordination should only require, at most, minor revisions to the placement and tilt of the radar facilities. Indeed, the fact that Trex itself proposed the very coordination process sought herein by CORF, suggests that Trex did not consider the process to be unnecessarily burdensome.

CORF recognizes that in para. 13, the Commission proposes a form of coordination through the National Telecommunications and Information Administration. CORF assumes that the Commission is referring to the Frequency Assignment Subcommittee of the Interdepartment Radio Advisory Committee (IRAC). CORF believes, however, that the coordination required here would not need the attention of all of the agencies of the IRAC, but rather, just the NSF and the Federal Aviation Administration (on behalf of the airport proposing to use the FOD radar). Direct

coordination between these two agencies is likely to be quicker, more efficient and less burdensome than the IRAC process.

Lastly, in para. 8 of the NPRM, the Commission seeks comments as to whether the 78-81 GHz band should be opened to non-FOD radars, on an unlicensed basis. CORF believes that it is ill-advised and inappropriate to open up a broader range of potential uses in this proceeding. The Commission already has an open docket (ET No. 10-23) to explore these issues and develop a detailed record for use of this band by tank level probing radars. Other potential uses, such as for automobile radars, could have such significant impacts, and involve complex regulatory evaluations, that rational rulemaking requires the issues to be fully vetted in a separate proceeding. In sum, it would be difficult, and perhaps impossible, for parties to properly comment on all of the technical and policy issues associated with other uses of this band, especially in the absence of specific proposals for those uses and the associated technical parameters.

III. Conclusion

CORF does not oppose sharing of spectrum in the 78-81 GHz band to permit fixed radars at airports for monitoring of FOD, as set forth in the NPRM. However, in light of the primary allocation of this band to the RAS, CORF believes that such a service should be a licensed one, with a requirement for coordination with RAS facilities through the Electromagnetic Spectrum Manager of the National Science Foundation. A coordination requirement should not be a significant burden on the operators of such radars, given the limited number of radio astronomy facilities that observe in the 78-81

GHz band, and the ease with which any potential interference could be mitigated. Lastly, the question of whether this band should be opened to other, non-FOD radar uses, would best be addressed in separate proceedings.

Respectfully submitted,

NATIONAL ACADEMY OF SCIENCES'
COMMITTEE ON RADIO FREQUENCIES

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Appendix A

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